

FACTSHEET: Electro-deionisation (EDI)

Singapore Achieves Breakthrough in Desalination Technology

As part of its continuous efforts to drive water innovation and research, PUB, together with its Research & Development (R&D) partner, Evoqua Water technologies have reached a milestone in improving the energy efficiency of seawater desalination resulting from a PUB challenge call from 2008 to 2011. Using electro-deionisation (EDI) technology, PUB and Evoqua had successfully demonstrated an achievable energy consumption of 1.65 kWh/m³ at a 50 m³/day pilot plant in 2009 using hand-built proof-of-concept modules. This is less than half of the energy used in current desalination methods. Fast-forward to today, Evoqua and PUB has overcome the gap in technology translation and have implemented newly developed commercially manufactured EDI modules in a 3,800m³/day feed capacity plant for seawater desalination.

Desalination is the most energy intensive source of water in Singapore. Currently, the key technology for desalination is reverse osmosis which uses about 3.5 kWh to produce one cubic meter of desalinated water. This compares to about 0.2 kWh/m³ for treating water from the reservoirs. With the current method of desalination and anticipated growth in water demand, energy use is expected to quadruple by 2060. Hence, PUB places much emphasis on developing lower energy technologies for seawater desalination.

Patented Nexed™ EDI Technology

Reverse osmosis pushes seawater, which contains about 3.5% of dissolved salt, under high pressure through membranes that filter out these dissolved salts and minerals, resulting in pure drinking water. EDI technology, on the other hand, uses electric currents to extract this 3.5% of dissolved salt at ambient pressure to produce pure drinking water. The lower operating pressures of EDI technology offers the promise of lower energy consumption.

PUB and Evoqua's pilot project in 2009 had used hand-assembled EDI modules to demonstrate the effectiveness of such technology. The ongoing demonstration project at Tuas builds on key insights gained from the pilot and utilises Evoqua's patented Nexed™ EDI module technology. Evoqua aims to operationalise and develop a module viable for mass production which can be used at a full scale desalination plant. The Nexed™ module technology provides innovative features such as an advanced low-energy membrane, intelligent flow distribution, and tunable dissolved solids removal capability allowing new options for reduced energy use, costs and facility footprint.

Evoqua has successfully commissioned the final phase of this demonstration project on 23 March 2018, which involves installing 45 Nexed™ modules to treat 3,800m³ of pre-filtered seawater per day. This is the largest demonstration plant for EDI technology. Evoqua will continue to implement process and product improvements with this plant to achieve the desired low energy use.

PUB Facilitates Research to Lower Energy Use for Desalination

PUB launched a R&D facility in Tuas in 2014 to facilitate R&D in seawater desalination, with the purpose of accelerating the development of low-energy desalination technologies.

PUB's R&D partners are able to access centralised raw and pre-treated seawater feed and electricity. This enables them to conveniently install their technology for plug-and-play access to actual seawater. Technologies are developed under true-to-life conditions, without impacting a 'live' desalination

plant. The facility has supported thirteen projects to date, including the EDI demonstration project by US-based Evoqua.

Potential to Scale Up EDI Technology at Tuas Desalination Plant

Singapore's future water security lies with desalination and reuse. These are rainfall-independent sources of water and can reduce our vulnerability to weather uncertainties. Desalination and NEWater can supply up to 85% of our water needs by 2060.

The opening of Tuas Desalination Plant (TDP) on 28 June 2018 marks a significant milestone in Singapore's journey towards water sustainability. Investments in such water infrastructure is essential in strengthening Singapore's water security. TDP boosts our water supply by 30 million imperial gallons per day (mgd), and can meet up to 30% of the nation's current water demands.

There are plans to further scale up the demonstration of EDI technology and operationalise it with a 10,000m³/day facility within TDP in 2019, once Evoqua's demonstration project meets all the deliverables of low energy consumption.